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Montana Department of Transportation

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STAGE I RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE:

Interim Evaluation of Three Instrumented Bridge Decks in Saco, Montana

II. PROBLEM STATEMENT:

Bridges are critical components of the nation's transportation infrastructure, but funds are becoming more limited just as the need for their rehabilitation and maintenance is rising. Over 30 percent of Montana's nearly 5,000 bridges, for example, were built between 1958 and 1972, creating a growing maintenance challenge for the Montana Department of Transportation. Much of the deterioration of the state's bridge decks can be attributed to the use of chemicals during winter maintenance activities. Therefore, it is desirable to use designs that limit the ability of corrosive agents to cause premature distresses within the decks. Several deck design strategies have been proposed in this regard. While planning the replacement of three bridges on Highway 243 north of Saco, Montana, bridge engineers at MDT recognized and seized an opportunity to evaluate the performance of three of these deck design strategies, namely:

1) a conventionally reinforced deck made with standard concrete;

2) a deck with reduced reinforcement and standard concrete designed according to AASHTO LRFD Bridge Design Specifications; and

3) a conventionally reinforced deck made with high performance concrete.

As these bridges were built by the same contractor (in 2003) and subsequently have experienced the same environmental and vehicular conditions, they offer an excellent situation to compare the relative performance of these three deck configurations.

For two years following construction, the bridges were monitored to study their relative performance. Annually, the decks were surveyed to analyze global movements, checked for cracks and delaminations, and tested for corrosion potential. Sensors embedded during construction and a weather station mounted nearby were also monitored to analyze strain in the rebar and concrete under varying environmental conditions. Data collected from summer 2003 to summer 2005 as part of the original project provided a good baseline for performance comparisons. Over this period, only subtle behavioral differences were observed between the relatively young bridges.

III. RESEARCH PROPOSED:

This project will provide an updated look at the performance of the three bridge decks (i.e., six years after their construction). Data will be collected consistent with that previously analyzed (with the exception of a controlled live-load test). Specifically, the project will include assessment of visual distress (cracking, delamination, and approach settlement), deck elevations (topographic survey for global movements), concrete shrinkage (measured from specimens collected when bridge decks were cast and stored on-site), and corrosion potential (half-cell potential and carbonation tests). Additionally, data from the sensors embedded in the bridge decks at the time of construction may offer insights to internal deck behaviors that may not be as obvious from the periodic observations of deck conditions. The three data acquisition systems will be returned to the bridges to determine which of the 64 sensors installed in each bridge deck still work, and remote connectivity with the sensors will be reestablished to facilitate efficient communication and data collection. The sensors will then be monitored for a relatively short period of time (1 to 3 months), and the data will be compared to that collected from summer 2005. Finally, any maintenance performed on the decks since construction (such as grooving, sealing, etc) will be documented with its associated costs. This information will be necessary for a life cycle cost evaluation,

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which is critical to the basis of any recommendation to implement any particular deck design in future construction.

IV. IT COMPONENT:

The work proposed herein does not require IT hardware, software or support.

V. URGENCY AND EXPECTED BENEFITS:

The proposed research has the potential to identify the most cost-effective design of the three bridge deck configurations investigated in the original project. Longer lasting bridge decks will reduce the funds required for rehabilitation and maintenance, funds which will continue to be stretched thin in the foreseeable future.

While the Saco bridge decks are still relatively young (they will be six years old in summer 2009), it has been several years since they were last assessed. It is anticipated that the long term sensors in the decks will still be functional, although an increasing number of these sensors may be lost with each passing year (note that the strain gages chosen for the original dynamic load tests are known to have a shorter lifespan than those selected for long-term study, and that failure of these sensors over the past few years was expected).

VI. IMPLEMENTATION PLAN:

One optimistic goal of the original project was to be able to identify the deck design that offered the best performance in consideration of known and projected costs. Due to the similarity in the behaviors of the relatively young bridges at the time of completion of the original study, a definitive recommendation on preferred deck configuration could not be made. However, an updated investigation may provide adequate information to support a recommendation that future bridge decks be designed using one of the three configurations considered in this project.

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Note: Submitter may attach continuation sheets if necessary.